



Pros & Cons of the Soil Quality Concept As Seen by a Skeptic

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"Honest disagreement is often a good sign of progress." --M.Gandhi

- 1. Sojka+Karlen 13**
- 2. Karlen+Sojka 8**

"A man does not attain the status of Galileo merely because he is persecuted; he must also be right."

-Stephen Jay Gould

None of us is being persecuted, and probably all of us have less than perfect views



Why Debate The SQ Concept?

Initially: asked to do so for editorial balance in SSSAJ

RE: Concerns about reviews of SQ journal papers

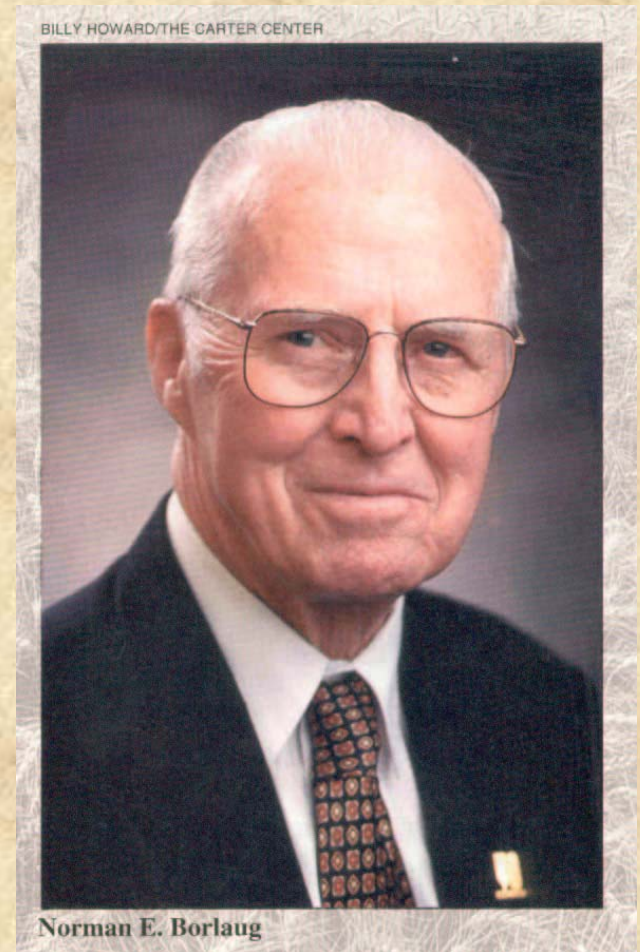
RE: Institutionalization without adequate research, with potential for implementation pitfalls.

RE: Regulatory and legal implications.

RE: Conceptual ambiguities, contradictions, biases.

RE: Impacts on scientific priorities.

RE: Repeatedly unanswered technical questions.



Co-Authors have included: N.E. Borlaug, D.K. Cassel, J. Letey, K.R. Olson, W.A. Payne, S.E. Petrie, G.H. Price, R.J. Reginato, P.A. Sanchez, H.D. Scott, M.J. Singer, P.J. Smethurst, L.A. Sparrow, G.B. Triplett, D.R. Upchurch,

Science Involves Skepticism & Challenges

1. Observation, Hypothesis, Data, Interpretation
2. Simplest Interpretation That Fits *All* The Data
3. Sci's *DUTY* : Note / Investigate Inconsistencies

“Truth in science is the simplest explanation that includes all known facts, no more and no less.” --Edward Teller

“Nature is not embarrassed by difficulties of analysis.” --Augustin Jean Fresnel

“Nature does not 'know' what experiment a scientist is trying to do. God loves the noise as much as the signal.” --L.M. Branscomb

Soil Quality Concept Positives

- A “tracking tool” for long term management of public lands, public financed programs on private land, etc.
- *Simpler* assessment language / “educational tool” for farmers.
- Appropriately increased emphasis on soil micro- and meso-biota.
- Seeks new ways to draw attention to soil attribute management (especially via “holistic” or systems approaches-- Good if holistic is not selectively, narrowly, or pc-defined).

Offsetting Concerns?

- Tracking tool for long term management. **This is not an innovation, other than the vocabulary and the packaging. Can it distract from established efforts, or focus on the wrong outcome-- ie soil attributes, vs overall landcare, yield, production, *profit* etc?**
- “Simpler” language / education tool for farmers. **Is it so simplistic that it can create more lack of understanding than it builds? Risking poor systems understanding and flawed management decisions?**
- Micro- and Meso-biota. **Total vs selective biodiversity? Do we really know enough yet to set broad standards? Can’t even selectively culture or functionally type 99% of soil microbes.**
- Draw attention to soil attribute management (especially via “holistic” or systems approaches). **But does it get conservation “off message”? Detract from targeting specific problems already well recognized and targeted? Unanswered questions regarding simultaneous conflicting “functions”– opposing functional optima– (20+).**

In Science Just Saying Something “Is” or “Isn’t”... Doesn’t Make It So

**(Science vs Policy, Programs, Politics &
Political Correctness)**

**The difficulty of Institutionalization of Scientific
Interpretation**

Action Agency Personnel Know that a Certain “Tension” Exists Between Institutional Priorities, Policy, Programs, Politics, PC... and Science

"To the adherents of the institutional truth there is nothing more inconvenient, nothing that so contributes to discomfort, than open, persistent articulate assertion of what is real." --John Kenneth Galbraith

**"Reality must take precedence over public relations, for nature cannot be fooled."
--Challenger Inquiry**

"The stupor of authority is the greatest enemy of truth" --Albert Einstein

Problems of Institutionalization

Soil Quality, used as a casual or generic term, acknowledging subjectivity by each user at each use raises no controversy.

But, it is being promoted as a technical scientific term for institutional ends: policy, subsidies, regulations etc. Many potential problems.

As with *Beauty* or *Obscenity* etc., you can know what it means to you at a given time, in a given context... but when trying to communicate it, generalize it, codify it, or make rules to reward or punish it, the task's subjectivity risks many potential pitfalls and unintended outcomes.

Much of the soil quality literature does not define or quantify (ie prove) parameter optima, yet still refers to “improved, good or better” values.

Institutional proponents do not acknowledge to users the existence or depth of scientific disagreement regarding the concept (conflict of interest)

Institutional mindset has the SQ concept taking credit for or being seen as the only approach to long established principles of soil management and edaphology, eg reduced tillage, carbon sequestration, nutrient management planning, waste utilization, forest and range management etc. All these existed long before the SQ concept, are not dependent upon it, and, in fact may be confounded by it.

Problems of Definition

- **Define to address specific functions**
 - But functions are multiple, simultaneous, and often have contradictory needs, e.g. enviro vs agro.
- **Define to suit specific soils**
 - Over 26,000 soil series in the US alone
- **Define to suit specific crops / cropping systems**
 - Vast number of possibilities
 - Complicated continually by climate & mgmt. constraints
 - Complicated by govt. programs, economy etc.

Logic Corollary: *That which is infinitely defined is undefined and undefinable*

The Problem of Definitions

- **Is “Soil Quality” simply a less-specific version of established concepts like Productivity / Yield Index? Fertility Index? Capability Class? Drainage Class? Erodibility Index? Hazard Index? Etc.?**
 - **But more overarching? Vague? Confusing? Conflicted?**
 - **At a technical level, when simultaneity and conflicting functional optima are unresolved, it is an academic problem**
- **Can the broadness of definition (ambiguity?) cause more problems than it solves?**
 - **Especially in the hands of non-soils-trained interpreters... like regulatory enforcers, politicians, lawyers, etc.?**
 - **At an institutional level, when simultaneity and conflicting functional optima are unresolved, it is a regulatory, legal or financial problem**

Possible Soil Quality Criterion

- So-called “Baseline” undisturbed condition (EQ)
 - Often low yield potential.
- Best Properties For Intended Use (Function?) e.g. yield or enviro-protection
 - Which function? When? What about other simultaneous functions?
- Sustainability (?)
 - Oxymoron with EQ... Nature doesn’t sustain, it adapts dynamically.
 - Humans choose what functions to sustain, vs Nature’s “Que Sera Sera.”
- Biodiversity (?)
 - Oxymoron with EQ for an agricultural context (Boris Zeide).
 - Crop production & soil microbiology evaluated on ability to support crop *monoculture*, favors only limited & selective diversity, NOT “Nature’s Equilibrium” for the climate and potential non-ag biodiversity
- Platonic Ideal of Soil (?)
 - “Soil quality” often used this way in the literature... *Improved B.D.*, *Improved Infiltration*, *Improved pH*, Etc. without stating/proving the criteria.
- Natural (?)
 - The word “Natural” in an Ag-context is an entirely arbitrary, anthropocentrically assigned connotation, transient (PC?) term...is it just an obfuscation for an “organic” agenda?

Quality Assessment Requires “Valuation” to Enable Evaluation of Measurements

- **SQ Assessment (Unlike CEC, BD, ESP, pH etc.) Requires Non-Physical-Chemical-Biological Parameterization (i.e. an interpretational context & value system- Yield? Profit? Environment? Aesthetics? Govt. Programs? Organic? Sustainability?)– Whose Definitions? What Impact of Inconsistent Interpretations / Parameterization etc? How to Handle Simultaneous Functions?**
- **At Best This Is Function/Use Calibration.**
- **At Worst This Can be PC-Driven Rather Than Outcome-Driven, or Otherwise Cause Serious Regulatory, Legal, Operational, or Economic Impacts.**

Problems With “Simultaneity”

Many Institutionally-Specified Simultaneous Functions Require Different Parameter Optima:

- ***Plant Productivity**
- ***Animal Productivity**
- ***Water Quality (purity- TMDLs).**
- ***Air Quality (purity- PM10 & PM2.5)**
- ***Human Health**
- ***Human Habitation**
- **Biodiversity and Productivity**
- **Partition Water & Solute Flow**
- **Provide Filtering and Buffering**
- **Optimize Nutrient Cycling**
- **Provide Structural Support**
- **Etc.**

Problems With Specific Index Parameters & “Simultaneity”

20+ specified in the literature, Examples:

- **Macropores- drainage vs bypass flow**
- **Nutrients- fertility vs runoff enrichment**
- **Biodiversity- beneficials vs pathogens etc.**
- **Contaminant- pesticides benefit vs hazard**
- **Contaminant- pollution vs sequestration**
- **Salinity- plant stress vs soil structure**
- **SOM- structure vs trihalomethane precursor**
- **Water retention- plant water vs aeration**
- **Bulk density- seed contact vs rooting vs traction**
- **Etc. etc. etc. + Interactions!!**

Soil Organic Matter **Positives**



- **Widely researched growth and productivity benefits**
- **Plant nutrient cycling**
- **Soil physical properties: soil structure, porosity, aeration, BD, CI, temperature**
- **Substrait for soil meso/micro ecology**
- **Chemical complexing and Carbon immobilization**



"Few things are harder to put up with than the annoyance of a good example." -Mark Twain

Soil Organic Matter **Negatives**



- SOM-based SQ mgmt can lead to logistic, economic, nutrient balance, salinity, coliform runoff etc. issues if manure or other organics are the sole nutrient/tilth strategy**
- High SOM content suppresses VAM efficiency**
- SOM > DOC in soil water, springs, surface/groundwater**
 - precursor to THM during chlorination**
 - substrate for profile or fluvial denitrification**
 - profile application of denitrification inhibitors**
 - Nitrous Oxides & global warming 320:1 vs CO₂**
 - complexes/mobilizes P, heavy metals, pesticides**
- SOM > Aggregation > macroporosity > bypass flow of nutrients, and Chemical or bio-contaminants**
- SOM > macroporosity > soil water retention loss at low tension**
- SOM > greater weed seed bank size and weed population**
 - reduced incorporated herbicide efficacy**
 - increased app. rates, costs, loading, exposure**
- SOM > High soil temp in hot climates/periods reducing yeild/qualtiy**

Problems With Specific Index Parameters

- No SQ proponent has given specific one-to-one technical responses to these lists of parameters having conflicting simultaneous functional optima, despite repeated high profile fora pointing them out and noting the implications to the institutionalization of the concept.
- Conservation Security Program (CSP) may bring some of these contradictions into contention, as will Individual states' land management regulations.

Analytical Overkill or Index-aholism

(Not Every Soil Problem Needs a 32 Step Identification Program)

**Most Land Managers Know
What Their Key Problems
Are Without the Need of
Complex Analytic Tools**



**"Not everything that counts can
be counted. Not everything
that can be counted counts."**

--Einstein

INTERPRETATION

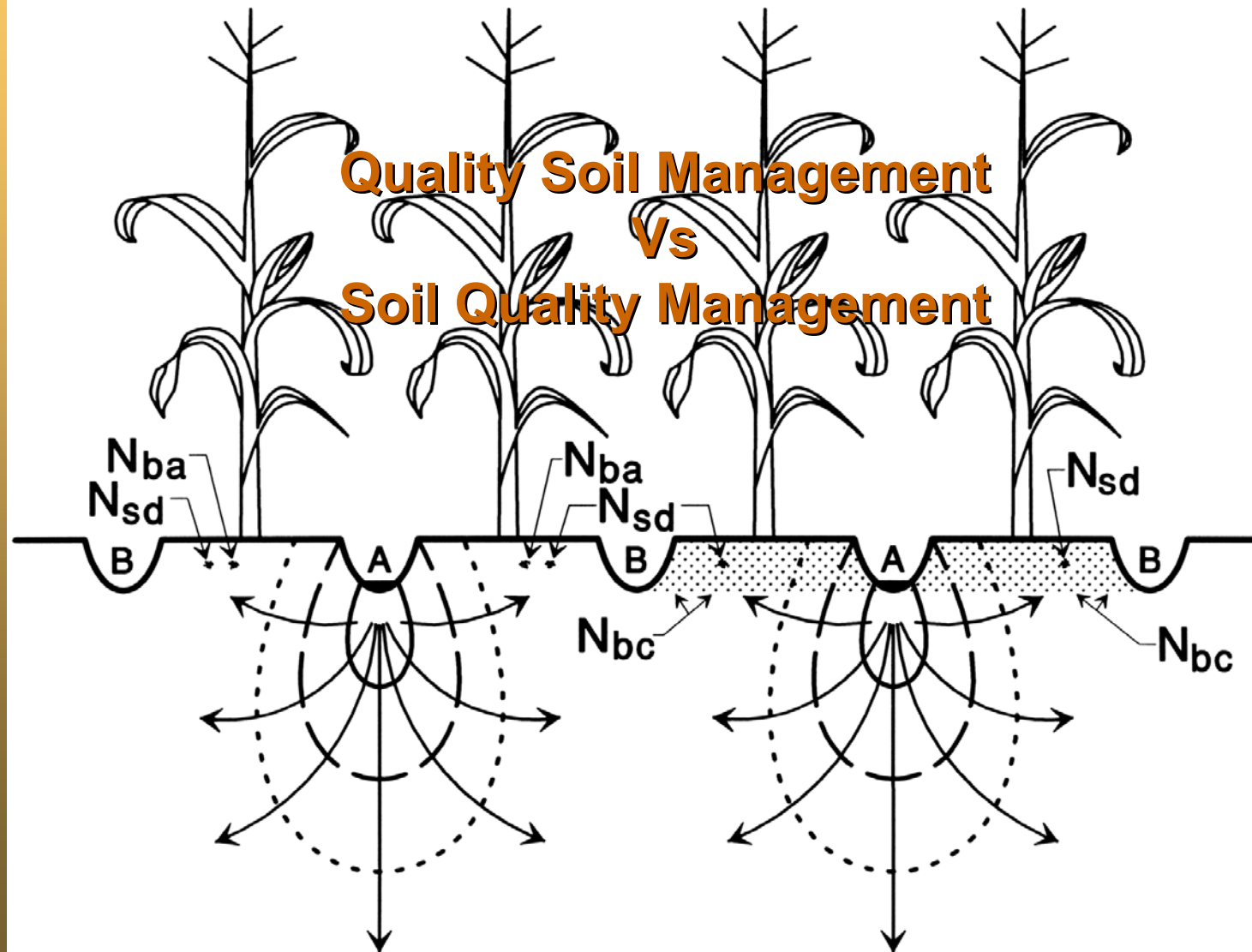
- Is soil organic matter GOOD?
 - YES and NO (it's just another property)
- Is soil organic matter BAD?
 - YES and NO (it's just another property)
- True “Holistic” interpretation demands FULL systematic consideration and quantification of ALL the positives and ALL the negatives
- If soil quality indices are “simplistic” rather than merely “simple”, or PC-slanted toward an organic-based philosophy they could result in problems upon regulatory or action-agency program use

Salt Management via Irrigation: Excellent production on a soil with a low rating. Rating systems cannot anticipate a manager's ability or creativity. A no cost production solution without changing soil properties.

**Quality Soil Management
Vs
Soil Quality Management**



N-conservation via dry side banding and alternate furrow irrigation reduces groundwater nitrate contamination. A rating system cannot anticipate a managers ability or creativity. A no cost management solution to an important environmental problem.



CONCLUSIONS: 1 of 3

- **The soil quality concept offers potential promise for 4 significant aspects of land care.**
 - Tracking tool for long term management
 - “Simpler” language / education tool for farmers.
 - Micro- and Meso-biota.
 - Draw attention to soil attribute management (especially via “holistic” or systems approaches).
- **BUT... There are legitimate significant offsetting scientific & philosophical concerns**
- **To realize the promise, the SQ community needs to forthrightly acknowledge and specifically and quantitatively address these concerns, not repeatedly ignore them or trivialize them.**

CONCLUSIONS: 2 of 3

- **Definitions & value-based indexing are at the root of many scientific objections. These are not trivial “semantics” arguments and may lead to painful conflicts and legal challenges if applied to regulatory or incentive programs.**
- **Holistic analysis isn’t holistic unless it is holistic**
- **Recognize simultaneous conflicting functions & interaction**
 - **Larson & Pierce said SQ must look beyond production! Do it!**
- **But... Analytic overkill is a waste of analytic resources**
- **Action agencies have an ethical/professional responsibility to be open with users and acknowledge that the concept is disputed among scientists**

CONCLUSIONS: 3 of 3

- Recognize well-established existing priorities (eg erosion) rather than obscuring them in an umbrella SQ approach
- Cease SQ term use without definition or quantified parameter optimization, including interactions and impacts on simultaneous competing functions
- Institutional advocacy and deployment is in front of the science, this will continue to provoke criticism if problems are not acknowledged and dealt with forthrightly.
- Problems noted by the soil science community should be faced and dealt with, not ignored or met with denial or antagonism.
- The time for conceptual discussion (semantics?) is past, it's time for quantitative replies to the many specific technical concerns repeatedly itemized by soil scientists.



**Soil Science
and the
Soil Quality
Debate:**

**Are not Rocket
Science**

**They aren't nearly
that simple**

**“There are people in the world so hungry, that
God cannot appear to them except in the form
of bread.” -Mohandas Gandhi**



Questions?